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ABSTRACT

The role of reinforcement has long been an issue in learning theory. The effects of reinforcement in learning were investigated under circumstances which made the information necessary for correct performance equally available to reinforced and nonreinforced subjects. Fourth graders (N=36) were given a pre-test of 20 items from the Peabody Picture Vocabulary Test, selected to be above the subjects' ability level. Subjects were randomly assigned to four treatment groups as either performers or observers. A performer and an observer were paired for a learning session. For half of the pairs, the performer was reinforced after each correct choice. For the other pairs, no reinforcement was given. All subjects could look up correct answers. Ten days later subjects were given a post-test on the 20 items and received a nickel for each correct choice. Analysis of pre-test to post-test improvement in number of correct items revealed significant learning for all groups. Differential treatment effects examined in a two-way analysis of covariance performed on post-test scores yielded no significant effects of either reinforcement or degree of participation. Results suggest that when relevant information is equally available under reinforcement and nonreinforcement procedures, subjects learn equally well under each procedure. (Author/NRB)

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THE FUNCTION OF DIRECT AND VICARIOUS REINFORCEMENT IN HUMAN LEARNING

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The Function of Direct and Vicarious Reinforcement in Human Learning

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This study was designed to assess the effects of reinforcement versus nonreinforcement, and of direct participation versus observation, on learning in human subjects. The role that reinforcement plays in learning has been a central issue in learning theory for the past eighty years or more. E. L. Thorndike (1931) founded the "strong reinforcement" position at the beginning of the century when he took reward to be a direct cause of learning in stating his famous Law of Effect. Thorndike's view was elaborated further in the influential work of Clark Hull (1943), and in the concept of operant conditioning as developed by B. F. Skinner (1938).

In frank opposition to the strong reinforcement position was the point of view developed by E. C. Tolman (1932). Tolman suggested that reinforcement, as a strengthener of responses, or of S-R bonds, has nothing to do with learning after all. He maintained that so called reinforcers function merely as outstanding stimuli, which demand attention, and which can act as incentives. Learning, meanwhile, requires nothing but experience. Recent years have seen a resurgence of interest in Tolman's position. His influence is evident, for example, in the work of R. C. Bolles (1975) and of Albert Bandura (1977).

In an early study on observational learning in children, Bandura (1963) found that the observation of rewarded models produces an increase in the frequency of the same response for observers, while the observation of punished models produces a decrease in the appropriate response frequency for observers. In a further study, Bandura (1965) had three groups of children observe different films in which aggressive models were either rewarded, punished, or left without consequences. On a test trial, these groups performed appropriately to the treatments they had observed.

In a later test, however, all groups were offered incentives for reproducing the behavior of the previously observed model. Observers performances changed such as to suggest that learning about the model's behavior had actually occurred to an equal degree in all groups, regardless of which treatment they observed.

McCrearty, Marston, and Kanfer (1961) compared direct reinforcement to vicarious reinforcement in the conditioning of verbal behavior. They found that "performance" groups, receiving direct reinforcement, learned more than "observation" groups.

Hillix and Marx (1960), however, using a multiple choice learning situation, found that a group which received only information, as observers, learned better than a group of performers who received both information and reward. (The reward here was the spoken word "right", after a correct response.) Berger (1961) obtained similar findings, showing that observers recalled learned verbal material better than performers did.

Results of a somewhat similar nature were reported by Rosenbaum and Hewitt (1966). Their study, however, focused primarily on the effect of punishment of wrong responses. The task was the traversal of a multiple choice

bolt-head maze. Correct responses resulted in a green light while errors resulted in a red light and a brief 90-volt electric shock. The results showed that on a later test trial, more errors were made by performers than by observers.

Both Hillix and Marx (1960) and Rosenbaum and Hewitt (1966) suggested that performers may suffer some sort of interference effect during acquisition that does not influence observers.

The present study is similar in its interests to those of Hillix and Marx (1960) and Rosenbaum and Hewitt (1966). Unlike those studies, however, it compares both observers and performers in each of the two conditions of reinforcement and nonreinforcement. The study also makes use of small amounts of money to provide what is intended to be a straightforward application of reinforcement.

METHOD

Subjects

Subjects were 36 fourth-grade school children. They were randomly assigned to four groups of eight, nine, nine, and ten.

Apparatus

The task consisted of 20 items taken from the Peabody Picture Vocabulary Test, a test of hearing vocabulary (Dunn 1965). On each item of the test four sketches or drawings are presented on a page of a spiral bound book. Subjects are given a word and asked to point to the drawing which best describes the word. The level of difficulty of the items chosen for use in the experiment was well above the performance level expected for students of the age level of the subjects. In addition to the Picture Vocabulary testbook, a second spiral notebook containing, on separate pages, the answers to each test item, was provided each subject during acquisition. Nickels were used as reinforcers in one of the experimental procedures.

Procedure

All subjects were given a pre-test in random order to establish a baseline performance. Subjects were then told that they were participating in an experiment on word and picture association, and that they should strive to follow the instructions of the experimenter. After being randomly assigned to four groups, subjects received acquisition trials and test trials in a balanced sequence to control for time of day.

Subjects were given acquisition experience in pairs, each pair being comprised of a performer and an observer. The subjects assigned to Group I (Reinforcement-Performance) were seated at a table across from the experimenter. They were presented with the testbook and the information notebook before the experimenter stated the first stimulus word. Subjects were requested to point to the picture which best represented the word. They were then asked to consult the information notebook concerning the item in question. If the initial response was correct, subjects were immediately rewarded by the phrase "That's right!", and by the presentation of a nickel. If, however, the initial response was incorrect, subjects were allowed to correct themselves and were then reinforced by the phrase and the nickel.

Subjects assigned to Group II (Reinforcement-Observation) were seated beside the subjects in Group I and were urged to watch the performer, and the consequences of the performer's responses. The subjects in Group II shared with Group I subjects a copy of the information notebook so that they could find information on the correct response simultaneously with the performer. Group II subjects were requested to remain quiet and simply to observe the fellow student as he worked.

Subjects assigned to Group III (Nonreinforcement-Performance) were seated in the same manner, and asked to perform the task in the same way as were Group I subjects. Group III subjects, however, were not given a nickel or any positive or negative verbal comment as a result of their responses. After each response the subject was simply asked to check his answer by consulting his information notebook. If the answer was correct, he proceeded to the next item. However, if the answer was incorrect he was asked to state the correct answer before proceeding.

Subjects assigned to Group IV (Nonreinforcement-Observation) were seated beside a subject in Group III, and were asked to observe the materials and the performance of the fellow student. They were asked to follow the performer's progress by checking his answers in the information notebook. Subjects in this group were not given any direct reinforcement and did not observe any reinforcement being administered to a performer.

All subjects completed acquisition in the same school day, with each pair of subjects covering the task in approximately 10 minutes. A single presentation of the 20 test items constituted the acquisition session. Ten days after acquisition, all subjects were tested individually. During this test, subjects were promised, and were given, a nickel for each correct response. The use of this positive incentive on the post-test was designed to insure maximum performance in all treatment groups.

RESULTS

The measure of primary interest was the number of items correct on the post-test. These scores were analyzed by means of a two-way analysis of covariance with subject sex as the covariate. Main effects were sought for reinforcement versus nonreinforcement and for performance versus observation. Neither of these main effects was found to be significant, nor was there a significant interaction. The results of the analysis are summarized in Tables 1 and 2.

Since there were no differences found among the treatment groups in performance on the post-test, it becomes a question of critical interest whether any learning occurred in the experiment. Table 3 indicates the degree to which the performance of each group improved following the learning experience provided by the present procedures. The *t*-test for matched pairs was performed on the pre-test versus post-test scores to determine whether learning had occurred to a significant degree in each group. The *t* values and associated probabilities resulting from these analyses are shown in Table 3. It can be seen that all of the obtained *t* values were significant at the .01 level of confidence, two-tailed.

Taken together then, the results indicate that a significant amount of learning occurred in all groups; but there is no evidence that either the degree of reinforcement encountered or the degree of participation required had an influence on the amount of learning.

DISCUSSION

The first question one might ask in view of the present lack of reinforcement effects is whether the reinforcer used was attractive and appetitive enough to be effective. Particular consideration went into the selection of a reinforcer in an effort to choose one which would provide a straightforward and clear-cut example of reinforcement. It was the purpose of the experimenters to provide a more obvious reinforcer than the phrase "right" as used in the study by Hillix and Marx (1960). The question of whether the nickel used in the present study was a genuinely appetitive stimulus may be answered by the observation that subjects often appeared overwhelmed by its presentation. They frequently made comments such as "wow!", "can I keep these?", and "I'm gonna get rich." Thus it appears that the reinforcer used was a genuinely appetitive stimulus.

A second possibility is that reinforcement could have been prevented from having an effect because of the occurrence of a "ceiling effect" in which all groups scored at the maximum level of performance attainable on the task. In connection with this point, it is important to note that no subject in the experiment scored the maximum possible number of items correct, and that the mean-score performance of the entire population on the post-test (9.86) was well below the maximum score possible (20.00). This observation indicates that there was no "ceiling effect" working to constrict upper variation of performance among the groups.

Another question which might arise is whether the actual degree of learning was adequately measured on the post-test assessment. It will be remembered that on the post-test all subjects were offered and received a nickel for each correct answer given. This incentive was offered to insure

that subjects would make maximum use of their acquired knowledge relative to the task. Subjects did appear strongly motivated to succeed; they appeared happy when they received the nickel and disappointed when they failed to receive it.

It appears, finally, that the only factor operating to effectively influence learning in the present case was the provision of information relevant to the learning task. The present procedures were designed to supply equally to all groups the information necessary to perform correctly on the task. This equal provision of information appears to have allowed for equal amounts of learning in all groups, regardless of reinforcement or degree of participation.

These findings agree with those of Hillix and Marx (1960) in that the actual receipt of a reward for correct performance failed to provide an advantage to the performer, as compared to an observer. The findings differ from those of Hillix and Marx, and others, in that neither in the reinforcement nor in the nonreinforcement condition was there a significant advantage to observers, as compared to performers. In fact, the small differences seen in the present study were in favor of the performer groups.

In relation to the two basic views of reinforcement discussed earlier, the present results must be considered as support for the view taken by E. C. Tolman (1932), and similar views held by others such as Bolles (1975) and Bandura (1977). But it may be important to note that the present task appeared to hold a high degree of intrinsic interest for the subjects. It is quite possible that a more boring or a more repetitive task would have yielded a different outcome.

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